

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
29 November 2001 (29.11.2001)

PCT

(10) International Publication Number  
**WO 01/90656 A1**

(51) International Patent Classification<sup>7</sup>: F24D 3/00, 3/18,  
12/02, F02G 1/043, 1/055, F24H 1/00

(21) International Application Number: PCT/NL01/00399

(22) International Filing Date: 23 May 2001 (23.05.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
1015319 26 May 2000 (26.05.2000) NL

(71) Applicant (for all designated States except US): ENATEC  
MICRO-COGEN B.V. [NL/NL]; Galileistraat 27,  
NL-7131 PE Lichtenvoorde (NL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): WAALDERS,

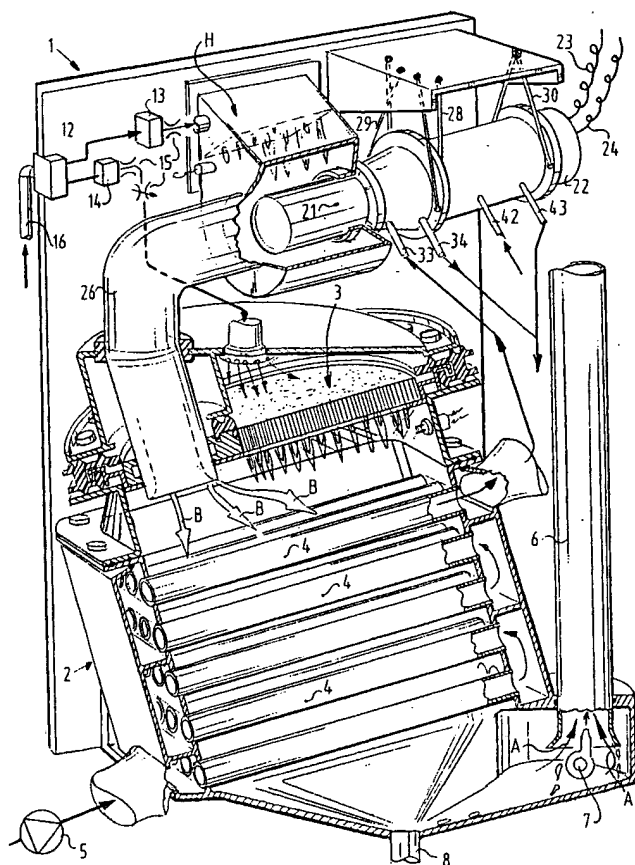
Erwin, Johannes, Maria [NL/NL]; Watersnipstraat 8,  
NL-7132 DG Lichtenvoorde (NL). HEZEMANS, Ronald,  
Hubertus, Theodorus, Maria [NL/NL]; Berkenlaan 156,  
NL-7064 HV Silvorde (NL). VAN WEZEL, Michel, Mar-  
tinus, Willen [NL/NL]; Badweg 10, NL-7061 AD Terborg  
(NL). BAIJENS, Cornelis, Alphonsus, Waltherus  
[NL/NL]; Lange Griet 8, NL-6932 ME Westervoort (NL).  
LUTTIKHOLT, Jozef, Johannes, Maria [NL/NL];  
Laagte 12, NL-7151 BS Eibergen (NL). BECKERS,  
Gerardus, Jacobus, Josephine [NL/NL]; Dorpsstraat  
54A, NL-1744 KL Sint Maarten (NL).

(74) Agent: LAND, Addick, Adrianus, Gosling; Arnold &  
Siedsma, Sweelinckplein 1, NL-2517 GK The Hague (NL).

(81) Designated States (national): AE, AG, AL, AM, AT, AU,  
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,  
CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM,  
HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK,  
LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX,

[Continued on next page]

(54) Title: APPARATUS AND METHOD FOR COMBINED GENERATION OF HEAT AND ELECTRICITY



(57) Abstract: The present invention relates to an apparatus for heating fluid in a pipe system, comprising: a first burner for heating pipes of the fluid circuit; a feed for air and/or fuel for causing combustion of this mixture by the burner; a second burner for heating a head of a generator for generating electrical energy; and an outlet pipe for discharging flue gases from the second burner into the space where the first burner is situated.

WO 01/90656 A1



MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL,  
TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

**Published:**

— with international search report

- (84) **Designated States (regional):** ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

APPARATUS AND METHOD FOR COMBINED GENERATION  
OF HEAT AND ELECTRICITY

Due to the liberalizing of electricity supply in Europe, it will certainly become attractive in the future to generate electricity locally in a home as well as heat. If an excess of electricity is generated, this  
5 electricity can be supplied to the public grid, thereby decreasing the electricity bill of the user. Transport losses are reduced considerably due to decentralized generation of electricity.

PCT/NZ99/00017 relates to a burner and a  
10 Stirling engine for generating electrical energy. The engine is herein arranged in the liquid tank to enable discharge of heat.

The European patent application EP 0 528 109 proposes feeding the exhaust gases of a diesel generator  
15 to the combustion chamber of a burner for heating water.

Known from the European patent application 0 455 510 and the British patent GB 2 174 799 is the coupling of a Stirling engine into a domestic circuit. This relates to a hinged deflecting plate for screening  
20 the head of the Stirling engine in relation to the burner.

The American patent US 4,534,319 describes a wood-burning stove with heat exchanger for heating water. This also includes electric resistance coils to prevent  
25 water from freezing.

The present invention provides an apparatus for heating fluid in a pipe system, comprising:

- a first burner for heating pipes of the fluid circuit;
- 30 - a second burner for heating a head of a generator for the purpose of generating electrical energy;
- at least one feed for air and/or fuel for causing combustion of this mixture by the burners; and

- an outlet pipe for discharging flue gases from the second burner into the space where the first burner is situated.

In an apparatus according to the present invention the heat from the second burner is used both to generate electricity using the generator and to heat fluid in the pipes. Both burners preferably take a modulating form. The first burner is preferably provided with a choke valve so that it can supply the heat demand, which depends for instance on outside temperatures, thermostat settings and the like.

Electricity is preferably generated with a so-called Stirling generator which is of compact dimensions and has proven itself in practice, for instance in space travel applications.

Such a Stirling generator has to be adapted to the frequency of the electricity grid, which is for instance 50 or 60 Hz, and will thus cause an (audible) vibration which is undesirable. The Stirling generator is preferably suspended resiliently from cables so as to prevent this undesired effect.

Further advantages, features and details of the present invention will be elucidated on the basis of the following description with reference to the annexed drawings, in which:

Fig. 1 shows a partly cut-away, schematic view of a first preferred embodiment of an apparatus according to the present invention; and

Fig. 2 shows a diagram of an installation incorporating the apparatus of fig. 1.

An embodiment of an apparatus 1 (fig. 1, 2) for combined generation of heat and power in the form of electricity comprises a heating part 2 in which a peak burner 3 is placed on the head side to heat pipes 4 through which water flows for space heating and/or to heat a boiler. For this purpose the water is circulated using a schematically designated pump 5. After the flue gases coming from the burner have flowed along pipes 4 in

downward direction, this flow is deflected as according to arrows A into an outlet pipe 6. In the present embodiment a fan 7 is included to discharge the flue gases. The apparatus is further provided on the underside 5 with a condensation drain 8.

The construction shown in fig. 1 and described above corresponds in considerable part with an apparatus currently marketed by the firm Atag Heating under the brand name "Blauwe Engel (Blue Angel) II".

10 In the apparatus according to the present invention a second burner 11 is further arranged which, as shown schematically in fig. 1, is connected to a gas feed line 12 shared with burner 3 via schematically designated control valves 13 and 14 in addition to a  
15 schematically designated control or choke valve 15 in the feed line 16 for the air, such as natural gas.

Burner 11 heats a head 21 of a Stirling generator 20 by generating electricity via lines 23, 24. Such a Stirling generator is known per se and described  
20 for instance in older American patents. The flue gases coming from burner 11 are forced along the head 21 for heating and guided via a pipe 26 as according to arrows B into the space under burner 13, whereby they likewise heat the water in pipes 4 to at least some extent and are  
25 discharged via chimney 6.

Through heating of the head 21 of Stirling generator 20 an alternating current of the desired frequency is generated by a generator part 22. Since the Stirling generator will therefore bring about an  
30 (audible) vibration, in the shown preferred embodiment the Stirling generator is suspended from wires 28, 29 and 30 which, as has been found in tests, prevent the vibrations being transferred to and being increased by a mounting plate and/or the housing.

35 As also shown particularly in the diagram of fig. 2 of an installation 30 incorporating the apparatus 1, a cooling is arranged in Stirling generator 20 close

to head 21 by means of a heat exchanger 31 which is connected in series behind heat exchanger 32. Temperature differences are thus reduced, and the efficiency of Stirling generator 20 and sufficient cooling are ensured.

5           As has been found, the system efficiency is maximal if the coldest fluid is used for cooling the flue gases, which is achieved by the above mentioned series connection. The connections 33 and 34 fed with partly fluid from heat exchanger 32, of heat exchanger 31 are  
10 likewise arranged in visible manner in fig. 1.

Further forming part of cooling circuit 35 are a pump 36, a three-way valve 37, radiators 38 and a heat exchanger 39 for a boiler such as are connected in practice for heating of houses (and on commercial  
15 premises). A middle part 41 of Stirling engine 20 is likewise connected to the circuit 35 via connections 42 and 43 in order to also avoid a (too) high temperature of this middle part.

In the preferred embodiment there is likewise  
20 arranged in a boiler 44 a so-called electrical dump resistance 45 which is connected to a line 46 to a grid circuit 47 which provides the connection to the schematically designated grid 48. Should the Stirling engine 20 produce electrical energy which cannot be  
25 delivered to the grid, this energy can be supplied to the resistance 45 for heating the water in the boiler.

In a further embodiment (not shown) an energy-dissipating element can also be arranged outside the boiler.

30           The present invention is not limited to the above described preferred embodiment thereof; the rights sought are defined by the following claims, within the scope of which many modifications can be envisaged.

## CLAIMS

1. Apparatus for heating fluid in a pipe system, comprising:
  - a first burner for heating pipes of the fluid circuit;
  - 5       - a feed for air and/or fuel for causing combustion of this mixture by the burner;
  - a second burner for heating a head of a generator for generating electrical energy; and
  - an outlet pipe for discharging flue gases
  - 10 from the second burner into the space where the first burner is situated.
2. Apparatus as claimed in claim 1, wherein the generator comprises a Stirling engine.
3. Apparatus as claimed in claim 1 or 2,
- 15 wherein the generator is suspended resiliently.
4. Apparatus as claimed in claim 3, wherein the generator is suspended from cables.
5. Apparatus as claimed in any of the foregoing claims, wherein the generator is provided with a cooling
- 20 circuit which is connected to the fluid circuit.
6. Apparatus as claimed in claim 5, wherein the cooling circuit is connected in series behind the fluid circuit of the first burner.
7. Installation for generating heat and
- 25 electricity, wherein an apparatus as claimed in any of the foregoing claims is applied which is connected to a boiler in which is placed a heat exchanger connected to the fluid circuit.
8. Installation as claimed in claim 7, wherein
- 30 an electrical resistance connected to the Stirling generator is placed in the boiler.
9. Apparatus as claimed in one or more of the claims 1-5, provided with a choke valve in the gas/air feed for the first burner.

10. Method wherein an apparatus as claimed in any of the claims 1-9 is applied.



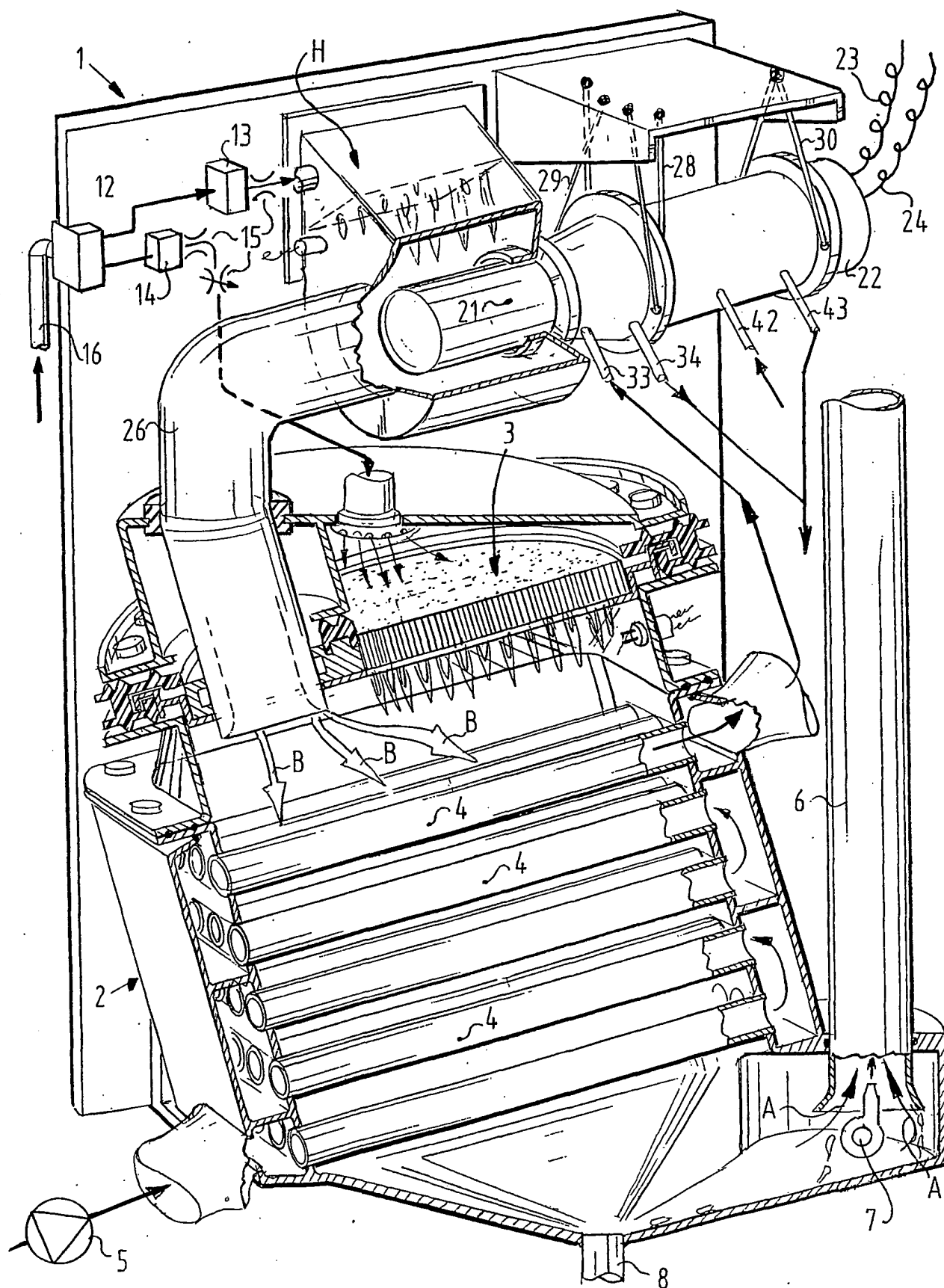


FIG. 1



International Application No

PCT/NL 01/00399

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC 7	F24D3/00	F24D3/18	F24D12/02	F02G1/043	F02G1/055
	F24H1/00				

According to International Patent Classification (IPC) or to both national classification and IPC

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F24D F02G F24H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 99 40310 A (AITKEN MURRAY BRUCE ;CLUCAS DONALD MURRAY (NZ); WHISPER TECH LIMIT) 12 August 1999 (1999-08-12) figure 1 abstract page 6, line 14 - line 31 ---	1,2,7,8, 10
A	EP 0 582 109 A (VETTER RICHARD) 9 February 1994 (1994-02-09) figure 1 abstract ---	1
A	EP 0 445 510 A (MESSERSCHMITT BOELKOW BLOHM) 11 September 1991 (1991-09-11) figure 1 abstract ---	1
	---	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*& document member of the same patent family

Date of the actual completion of the international search

3 July 2001

Date of mailing of the international search report

10/07/2001

Name and mailing address of the ISA  
European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Wassenaar, G

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 01/00399

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 174 799 A (MESSERSCHMITT BOELKOW BLOHM) 12 November 1986 (1986-11-12) figures 1,2 page 1, line 28 - line 120 abstract	1
A	US 4 534 319 A (MANNO JOSEPH T) 13 August 1985 (1985-08-13) figure 1 abstract claims 1-20	1,8

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 01/00399

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9940310	A	12-08-1999	AU 2553999 A	23-08-1999
			EP 1055060 A	29-11-2000
			NO 20003999 A	08-08-2000
			PL 335612 A	08-05-2000
EP 0582109	A	09-02-1994	DE 4226120 A	10-02-1994
			AT 158853 T	15-10-1997
			DE 59307450 D	06-11-1997
EP 0445510	A	11-09-1991	DE 4006742 A	05-09-1991
GB 2174799	A	12-11-1986	DE 3516962 A	13-11-1986
			FR 2581741 A	14-11-1986
			JP 61265443 A	25-11-1986
US 4534319	A	13-08-1985	NONE	